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Verification and Validation of DTRA's Unified EM Design

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Approved for public release

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Overview

- Unified EM Design Background
- Unified EM Design Software Architecture
- V & V Approach
- V&V Results
- Conclusion

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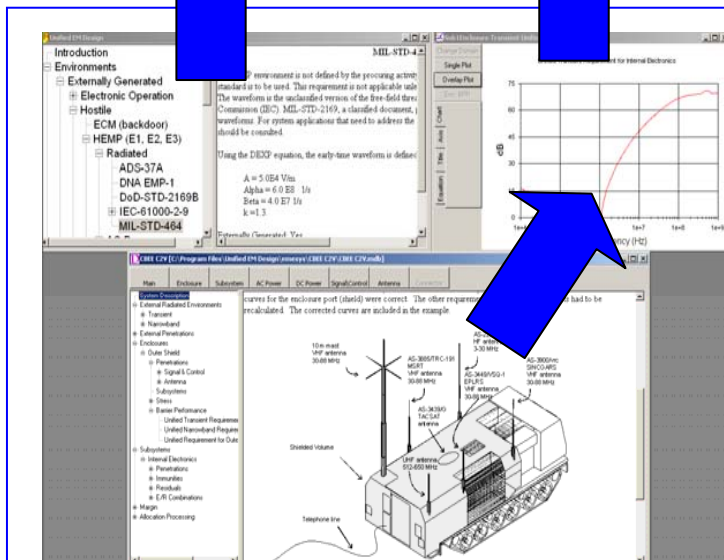
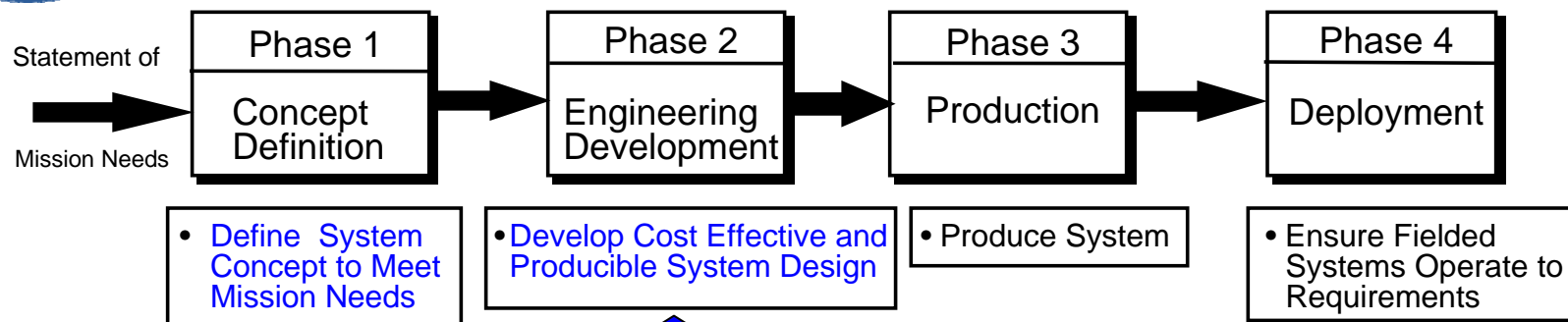
Background

- **JCS memo on combined battlefield environmental effects initiative, c. 1994**
- **Combined Battlefield Environmental Effects Initiative, 1995 - 1998**
 - Unified Protection Concept
 - Allocation Methodology
 - Evaluated Military and Commercial Standards
 - Prototype Unified EM Design Tool
- **Unified EM Design & Test Protocols Program, 1999 - 2004**
 - Unified EM Design Tool
 - Evaluation of potential for unified test methods
- **Advanced Unified EM Design Program, 2005 - Present**
 - Prototype DETES development
 - NuCS Capabilities integration
 - Verification and Validation



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Application of UEM



Unified EM Design provides:

- Access to EM Standards (Left)
- System modeling (Bottom)
- Unified Barrier Performance Requirements for enclosure and penetration ports (Right)

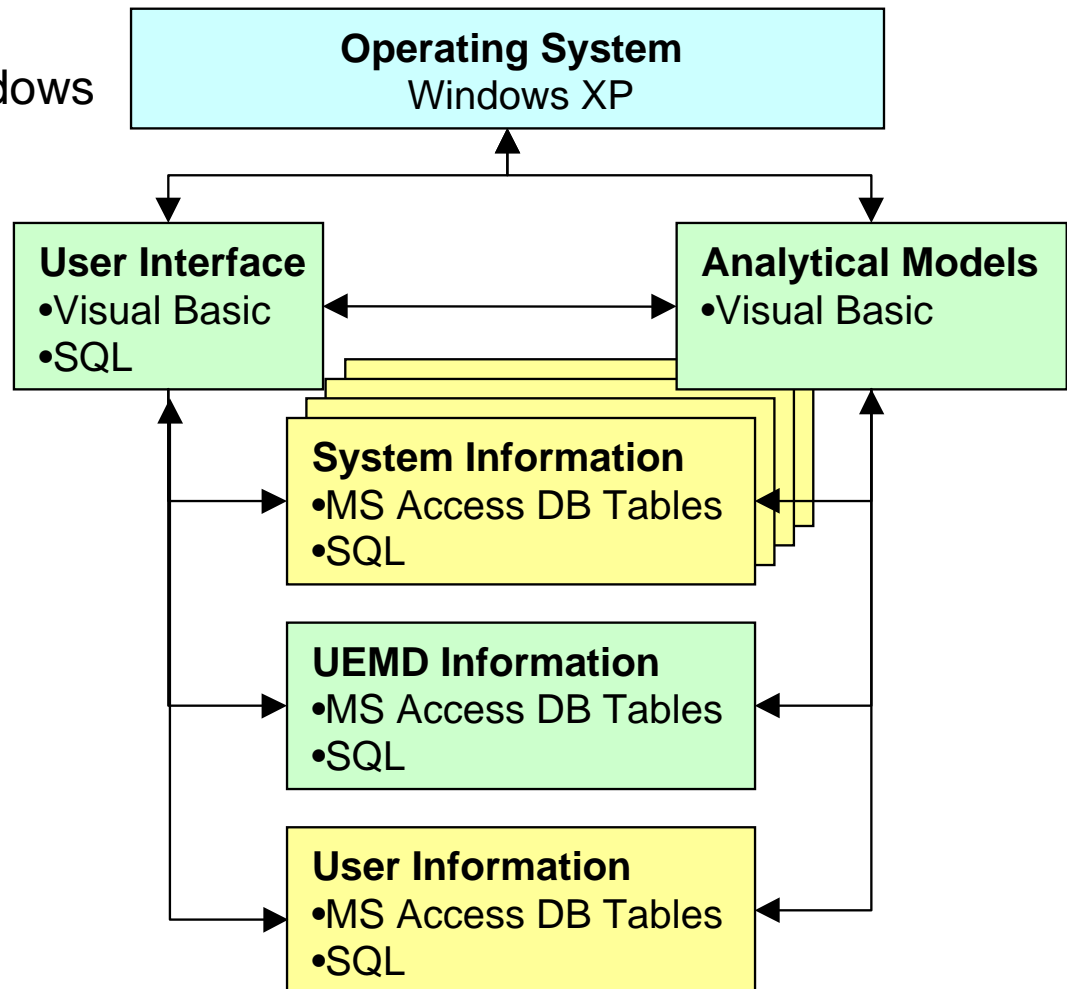
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Software Architecture

- Runs under all current Windows operating systems
- Major elements are:
 - User Interface
 - Analytical Models
 - Databases
- Databases have common structure
- Data in the UEM Design information database is protected



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V & V Approach

- Based on DTRA V&V Guide
- Assumes Level II Accreditation

V&V Activity	Accreditation Level
CM Assessment	I +
Documentation Assessment	I +
Software Quality Assessment	I +
Security Requirements Assessment (Not Required)	I +
Sensitivity Analysis	II +
Uncertainty Analysis	II +
Data V&V	II +
SME V&V (Conceptual Model, Logical, Face, & Results)	II +
Detailed V&V (Requirements, Design, & Code)	III

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Results for Level I+ Activities

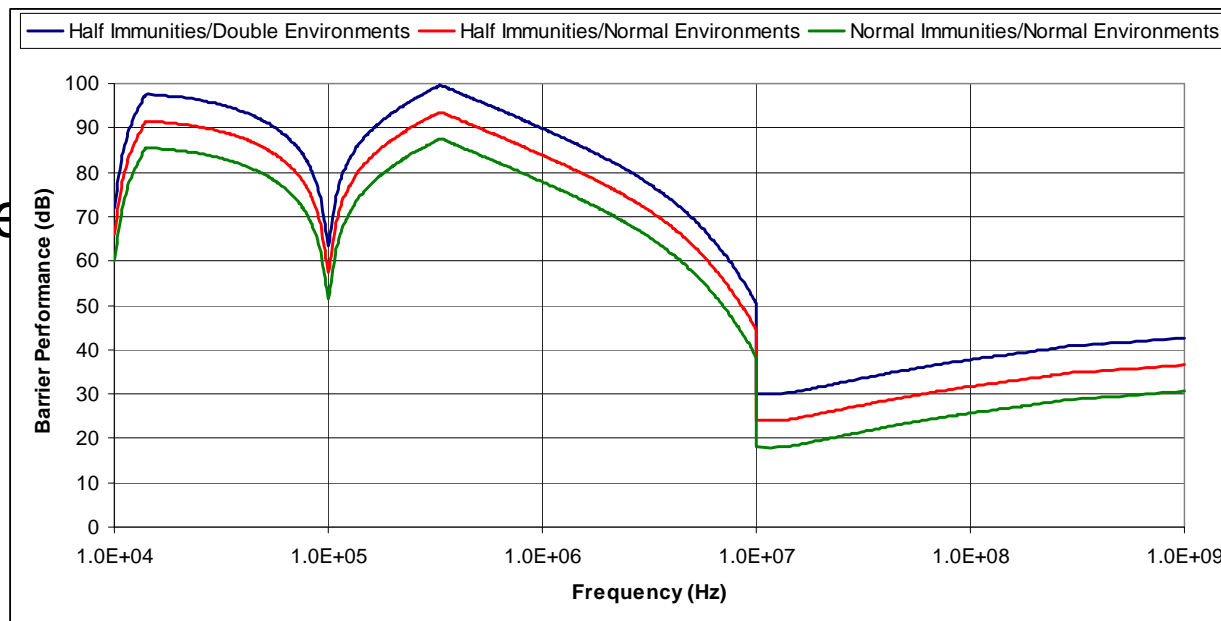
- CM Assessment looked at controls on software for maintenance and releases
- Documentation review
 - Independent review performed on V1.6
 - Verified current version documents consistent with V1.6
 - Verified new EM Quantity documentation
- SQA focused on outstanding program trouble reports (PTRs) and operational stability



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Example Sensitivity Analysis

- Barrier performance requirements calculation utilizes a non-linear bounding process
- Outputs will not vary linearly with input parameters in the large scale
- Sensitivity analysis over a limited range
- Example shows agreement within 0.2%



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Uncertainty Analysis Overview

Uncertainty	Risk Level	Discussion	Mitigation
Environments			
Radiated	Low	Based on Standards. Very low sensitivity study result.	
Conducted	Low to Moderate	Based on Standards or Worst Case Estimates. Low to moderate sensitivity study result.	Mitigators include use of test data or results from more accurate models and specifications.
Immunities			
Radiated	Low	Based on Standards. Very low sensitivity study result.	
Conducted	Low to Moderate	Depends on fidelity of model for conversion of standard's specified test procedure to penetration current. Low to moderate sensitivity study result.	Mitigators include use of actual test data and margin.
Margins	Low	Based on QSTAG 1051 procedures. User selectable to manage risk. Very low sensitivity study result.	
Topology	Low	Based on QSTAG 1051 procedures. No restrictions in Unified EM Design. Extensive user training also conducted.	
Barrier Performance	Very low to Moderate	Based on QSTAG 1051 procedures. Very low sensitivity study result.	Mitigators include Shielding Effectiveness testing, Current Injection testing, and System Level testing.

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Data V & V Analysis

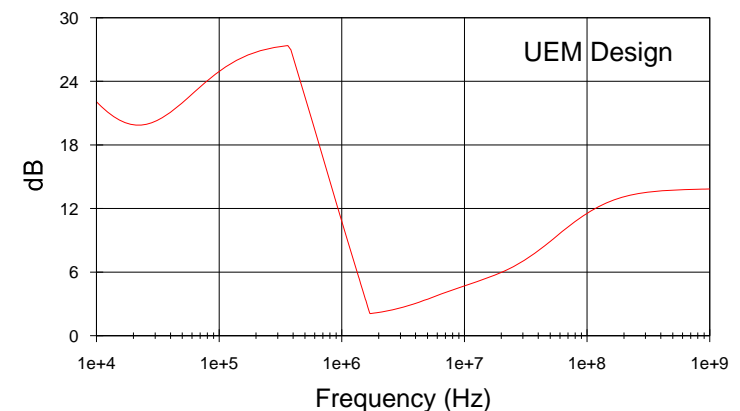
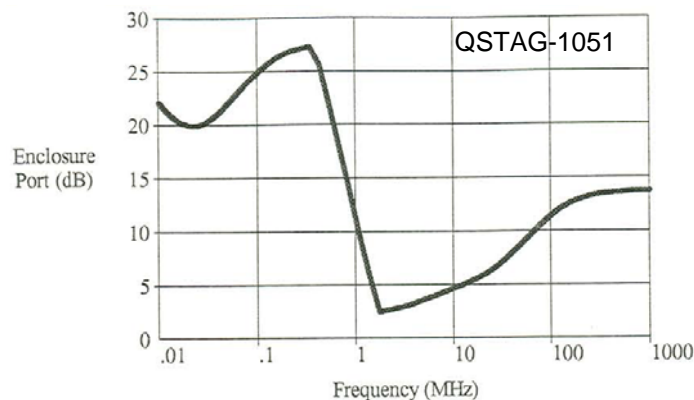
- Producer Quality
 - Vast majority of the data comes from commercial and military standards
 - Verification approach
 - 857 EM Quantity descriptions in UEM V2.3
 - Randomly selected 60 descriptions & verified them against the standards
 - Accuracy of 90% or greater with 95% confidence
 - Complete review recommend
 - Review will be completed before release of V2.3
- User Quality established by CBEE
- Instructional information in QSTAG 1051



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SME V & V

- Methodology was codified as part of the American, British, Canadian, and Australian Armies' Standardization Program - QSTAG 1051
- QSTAG 1051 includes:
 - Step-by-step procedures for the barrier performance requirements calculations
 - Logical verification of UEM processing
 - Example results



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Summary

- V & V approach based on DTRA guide
- Some of the V & V tasks completed as part of original development
- All V&V activities completed
- Draft V & V report available
 - V2.3 recommendations include complete data audit
 - Long term recommendations recommendations relate to maintainability and operation under new Operating Systems

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